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SYSTEM FOR CONNECTING PRECAST CONCRETE SLABS TOGETHER

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FIG. 4

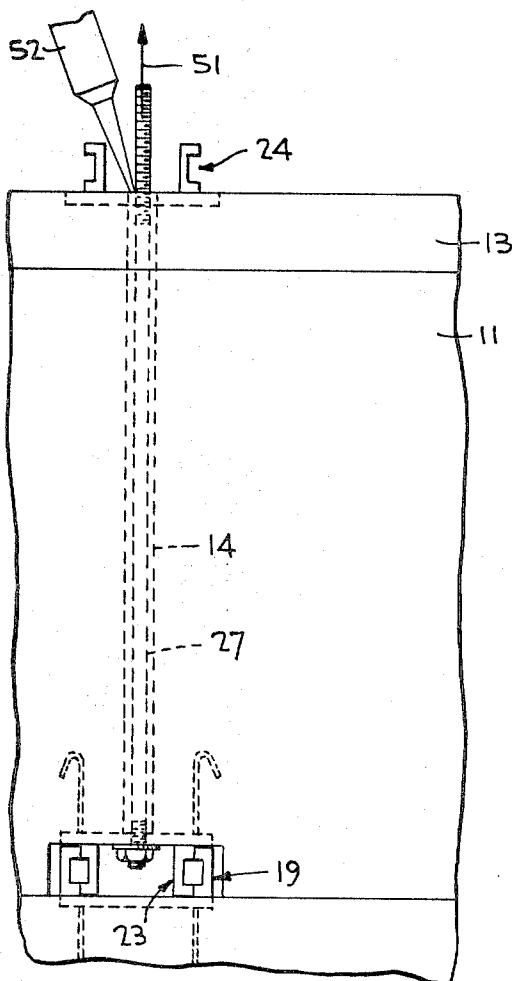


FIG. 1

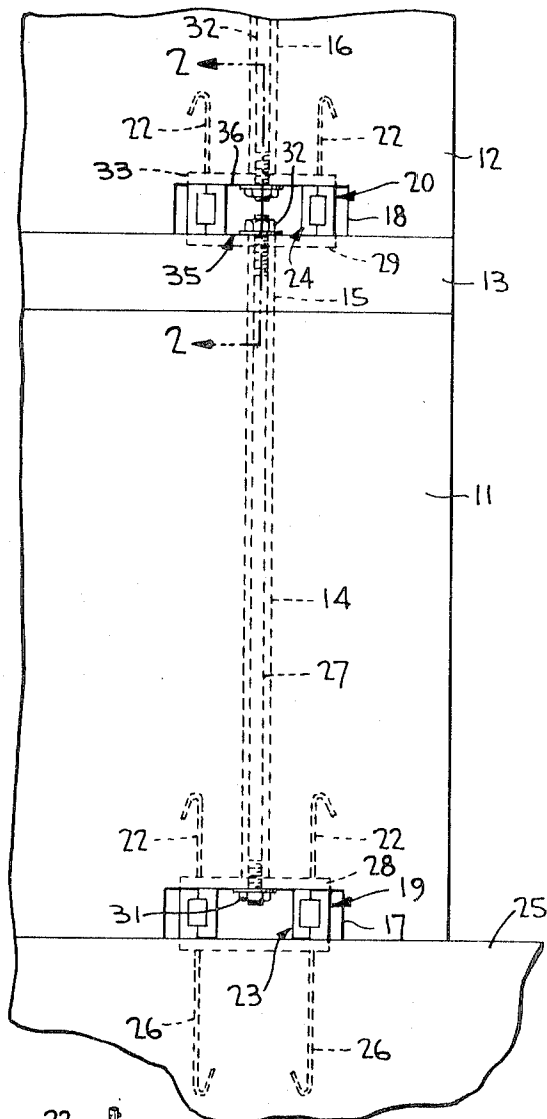


FIG. 2

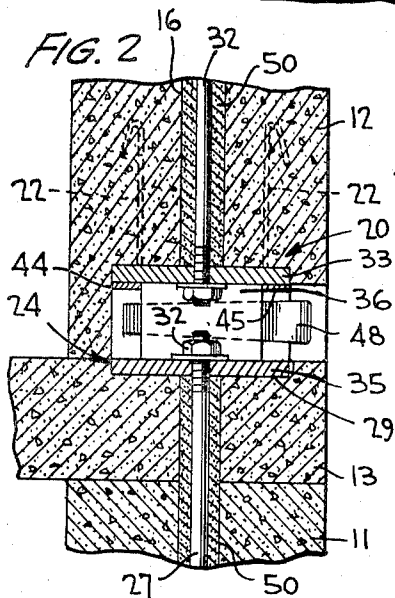
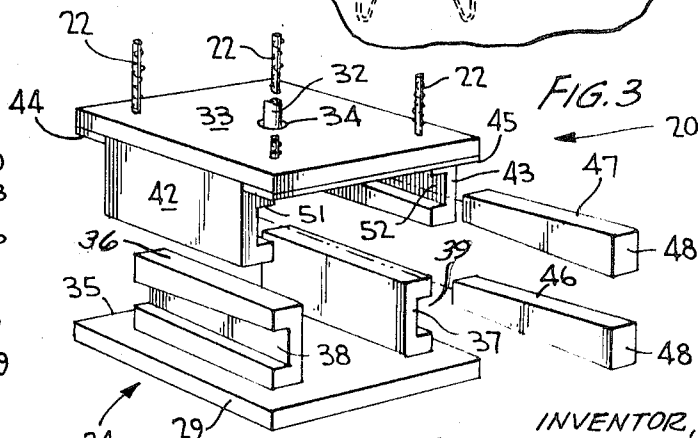


FIG. 3



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1

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SYSTEM FOR CONNECTING PRECAST CONCRETE SLABS TOGETHER

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9 Claims

ABSTRACT OF THE DISCLOSURE

Precast concrete slabs of a building are connected together with coaxial tensioned rods extending through aligned, elongated bores, running between edges of the slabs. In one of the slabs a cut-out is provided along one of the edges to receive one connector half fixedly positioned in the slab by tie-bars. A second connector half fixedly mounted on the other slabs projects into the cut-out of the first slab. Each connector half includes a base having a centrally located aperture therein for enabling a tensioned rod to be secured to an outer edge of the base. Extending from each of the bases is a pair of walls having parallel faces, each having a slot with sloping top and bottom edges. Faces on walls extending from one base are in abutting relationship with faces extending from the other base, with mating slots in the faces forming an enclosed groove. A wedge having sloping top and bottom surfaces fits into each of the grooves to form camming surfaces securing the two connector halves together. To prevent lateral movement of the connector halves, on one of the bases there are provided lips extending in a direction at right angles to the bore and longitudinal axes of the wedges.

The present invention relates generally to connectors for securing precast slabs together, and more particularly, to a slab connector wherein coaxial tensioned rods join building slabs together by a structure having a pair of enclosed grooves, formed by mating faces and slots to form camming surfaces for wedges having sloping top and bottom surfaces.

Numerous devices or systems have been developed to interconnect precast concrete slabs, such as are employed in the construction of buildings. Many of the systems developed have employed offset tensioned, steel tie rods extending through elongated bores in the slabs. Because the parallel tie rods are displaced there is a turning moment exerted thereby on a base connected to the tensioned rod. The turning moment on the base can cause instability due to shear forces being exerted on the precast slabs. To counteract the turning moment, an auxiliary tie bar has been provided, thereby increasing the amount of steel required.

While numerous systems employing coaxial, rather than offset, tensioned rods have been proposed, none to my knowledge has been widely received. Apparently, problems with interconnecting coaxial, aligned tensioned rods have precluded the use of such rods in fastening or connecting a plurality of precast concrete slabs together.

In accordance with the present invention, a plurality of precast concrete slabs are interconnected with coaxial, aligned post tensioned rods extending through aligned bores in adjacent slabs. The rods are connected together by a pair of connector halves, one of which is fixedly mounted in a cut-out along one edge of a first slab. A second connector half, fixedly mounted in a second slab adjacent to the first slab, extends from a planar surface of the second slab into the cut-out region. Walls of the connector halves have abutting faces with tapered slots therein to receive similarly tapered wedges. A camming action

2

between upper and lower edges of the tapered wedges and slots rigidly interconnects the connector halves in a first plane extending at right angles relative to the longitudinal axis of the elongated slots. Lateral movement of the connector halves in a second plane at right angles to the first plane is prevented by a pair of lips on bases for the connector halves. The wedges are easily inserted in place by a workman striking a mallet against a face thereof.

A further feature of the invention is that alignment of the slabs can be readily ascertained and achieved by causing one connector half to sit on a second connector half and moving one slab relative to the other until perfect alignment is achieved. Another feature is that there is no need to employ bolts for connecting the different tensioned rods together thereby reducing labor expenses.

It is, accordingly, an object of the invention to provide a new and improved system for connecting slabs forming buildings together.

An additional object of the invention is to provide a system for connecting building slabs together by utilizing coaxial, aligned tensioned rods connected to each other in a facile manner.

Another object of the invention is to provide a new and improved system for connecting building slabs together with mating connectors easily interconnected on the building site.

A further object of the present invention is to provide a new and improved device for interconnecting precast slabs utilized to form walls and ceilings of buildings, wherein the slabs are automatically aligned with each other by properly positioning connector halves for securing tension rods in situ.

Still another object of the present invention is to provide a new and improved system for interconnecting precast slabs in a manner reducing costs of labor and materials.

The above and still further objects, features and advantages of the present invention will become apparent upon consideration of the following detailed description of one specific embodiment thereof, especially when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a side view illustrating the manner by which slabs forming walls and horizontal members of buildings are connected together in accordance with a preferred embodiment of the invention;

FIG. 2 is an enlarged cross-sectional view, taken through the lines 2—2 of FIG. 1;

FIG. 3 is an exploded view of a connector employed in FIG. 1; and

FIG. 4 illustrates procedures for securing a rod in place in accordance with the invention.

Reference is now made specifically to FIGS. 1 and 2 wherein vertical walls 11 and 12 are illustrated as being separated by horizontally extending floor and ceiling member 13. Each of walls 11 and 12, as well as floor and ceiling member 13, is preferably a precast concrete slab that may be utilized to form a plurality of different types of buildings, as disclosed in my copending application entitled Buildings, Ser. No. 35,484, filed May 7, 1970.

The top and bottom surfaces of slab 13 abut with the bottom and top edges, respectively, of slabs 12 and 11. Slabs 11, 12 and 13 respectively include circular, elongated bores 14, 15 and 16 running approximately between the horizontal edges or faces thereof. Bores 14, 15 and 16 of slabs 11—13 are aligned with each other to form a continuous bore from the lower edge of slab 11 to the upper, planar surface of slab 13.

On the bottom edges of walls 11 and 12 are rectangular cut-outs 17 and 18 into which connector halves 19 and 20

3

are fixedly mounted. Connector halves 19 and 20 are held in situ in cut-out regions 17 and 18 by steel tie-bars 22, embedded in walls 11 and 12. Connector halves 20 are preferably fabricated from a relatively strong material having considerable shear and tensile strengths, such as steel, and are joined to the precast slabs during the slab casting operation.

Extending into cut-out regions 17 and 18 of wall slabs 11 and 12 are upwardly extending connector halves 23 and 24, respectively. Connector half 23 is fixedly secured into a concrete foundation 25 by relatively long, steel tie-bars 26, while connector half 24 is secured in situ on the upper, planar face of slab 13 by immersing the connector half 24 into the upper face of slab 13 while the concrete is cast. After the concrete is cast, connector half 24 is fixedly mounted in slab 13 by adhesive properties of concrete and steel. Because of the relatively weak bond between connector half 24 and slab 13, there may be a tendency for connector half 24 to separate from slab 13 in response to relatively large forces and/or torques applied to the slabs.

To overcome the tendency of connector half 24 to separate from slab 13 and enable slab 13 to be connected rigidly to wall slab 11, steel post tension rod 27 is provided. Rod 27 is of sufficient length to extend through bores 14 and 15 from the lower face of base 28 for connector half 19 to the upper face of a base 29 of connector half 24. Rod 27 is placed in tension at both ends thereof by nut and washer combinations 31 and 32; it is to be understood, however, that other means for tensioning rod 27 and holding it in situ may be employed. Coaxial with rod 27 is a further steel tension rod 32 extending from the lower face of base plate 33 for connector half 20 through elongated bore 16 to the upper planar face of a base for a connector half (not shown) at the top of a floor and ceiling slab extending horizontally in a direction parallel to slab 13. Coaxial tensioned rods 27 and 32 secure the various wall and ceiling slabs of the buildings together to avoid problems of the prior art relating to bending torques or moments exerted by offset tension bars.

Detailed views of connector halves 20 and 24 are illustrated in the cross sectional and exploded views of FIGS. 2 and 3, respectively. Since connector halves 19 and 23 are identical to halves 20 and 24 and are interconnected in the same way, the following detailed description of halves 20 and 24 is equally pertinent to halves 19 and 23, and corresponding parts are generally identified by the same reference numerals.

Connector halves 20 and 24 include parallel, horizontally extending, square base plates 33 and 29, respectively. Each of plates 29 and 33 includes a centrally located aperture 34. The upper and lower faces of base plates 29 and 33 are respectively coplanar with the upper face of slab 13 and the edge 36 of the horizontally extending segment of cut-out region 18 in slab 12.

Extending upwardly from face 35 of base plate 29 are a pair of parallel walls 36 and 37, having longitudinal axes at right angles to the faces of slab 12. The outwardly directed faces of walls 36 and 37 are respectively provided with horizontally extending slots 38 and 39, having elongated, tapered bottom and top edges. Extending downwardly from base plate 33 are parallel walls 42 and 43, having longitudinal axis extending in the same direction as walls 36 and 37. The inner faces of walls 42 and 43 are respectively provided with horizontally extending slots 51 and 52 having tapered upper and lower, elongated edges. The outer faces of walls 36 and 37 are positioned relative to the inner faces of walls 42 and 43 so that the faces are in abutting relationship when connector half 20 is brought into engagement with connector half 24. The heights of walls 36, 37, 42 and 43 are substantially the same, enabling a snug fit to be attained between the lower, horizontal abutting edges of walls 42 and 43 with

4

face 35 of base plate 29, as well as between the upper, horizontal edges of walls 36 and 37 against the lower face of base plate 33.

To prevent lateral movement of connector halves 20 and 24 relative to each other, lips 44 and 45 are formed on the lower bottom surface on plate 33 of upper connector half 20. Lips 44 and 45 are located at opposite edges of walls 42 and 43, and span the distance between at least the inner faces of the walls, thereby to lock the edges of walls 36 and 37 extending from base plate 29 in situ. Lips 44 and 45 serve the additional function of enabling bore 16 in slab 12 to be aligned with bores 14 and 15 in slabs 11 and 13, respectively, to facilitate assembly of the various slabs forming a building. Lips 44 and 45 could be located on base plate 35 of connector half 24 or one could be on base plate 35 and another on base plate 33.

To prevent vertical displacement between connector halves 20 and 24, and enable them to be secured rigidly in place, a pair of elongated wedges 46 and 47 are provided. Wedges 46 and 47 have sloping top and bottom surfaces, contoured to engage the sloping top and bottom edges of an enclosed groove formed by the slots in wall pairs 36, 37, 42 and 43. Wedges 46 and 47 have a width slightly less than the width of the enclosed groove so they are easily knocked into place within the grooves formed by the slots in walls extending from base plates 29 and 30 by a laborer striking a mallet against the enlarged outer faces 48 thereof. As wedges 46 and 47 are driven into the enclosed grooves, a camming force is exerted between the sloping edges thereof and the sloping sides of the enclosed groove due to the frictional contact between the sloping top and bottom edges of the wedges and grooves. Because of the relatively large contact area between the top and bottom surfaces of wedges 46 and 47 and the mating surfaces on the top and bottom of the enclosed grooves, the connector is able to withstand a relatively large shear force. The connector shear strength is sufficiently great to enable the walls of the building easily to withstand any forces normally encountered as a load.

Wall and flooring slabs are assembled together in accordance with the present invention by initially securing a plurality of connector halves, such as connector half 23, in the foundation, so that the connector halves extend above the foundation. Thereafter, wall 11 is placed on the foundation by aligning lips 44 and 45 of connector half 19 with the edges on the opposite sides of walls 36 and 37 of connector half 23. Prior to and while slab 11 is fitted into place, tension rod 27 extends through bore 14 and is held in place by nut 31 threaded on the end of the rod protruding through the lower base of base plate 28. Slab 11 is maintained in situ by suitable propping means, not shown, until all walls forming the first story of the building are properly located. After all of the walls are secured in place, ceiling slab 13 is lowered into place on the upper, horizontal edge of slab 11 and spans between a pair of parallel vertical walls, such as slab 11. After slab 13 is properly located, force is applied to the upper end of rod 27, by any suitable means (not shown), designated by arrow 51, to tension the rod and force nut and washer 37 against the lower edge of base plate 28. With tension applied to rod 27, nut and washer 32 are threaded onto the upper end of the rod and tightened. Thereby, rod 27 remains in tension to firmly secure slab 13 to wall slab 11. Any excess length of rod 27 protruding above the upper surface of nut 32 is now removed by cutting. Slab 12 is then placed on slab 13 and the remainder of the building is erected in the manner described for connecting slabs 11 and 13 together.

In certain instances wherein there is a possibility of erosion to steel rod 27 and/or additional strength may be needed to interconnect the slabs, column 50 of adhesive material, such as concrete, is poured into bores

5

14 and 15 and fills the cavity around rod 27. Under such circumstances, concrete is blown from source 52 through the centrally located aperture in base plate 29 while rod 27 is in tension prior to nut and washer assembly 32 being screwed onto threads of tension rod 27 so that it adheres to the sides of the bore 14 and rod 27.

While there has been described and illustrated one specific embodiment of the invention, it will be clear that variations in the details of the embodiments specifically illustrated and described may be made without departing from the true spirit and scope of the invention as defined in the appended claims.

For example, the tension rod and connector assembly can be utilized for interconnecting abutting horizontal floor and ceiling slabs. In such an instance, one of the directly abutting slab edges is provided with a cut-out having a connector half therein. The other connector half extends from an edge of the adjacent slab in abutment with the slab having the cut-out. The horizontally and vertically extending tension rods must be positioned so that they do not intersect.

I claim:

1. In combination, a pair of precast slabs having abutting surfaces at least one tension rod extending through each of the slabs between opposite surfaces thereof, a first tensioned rod in one of said slabs being contiguous to the abutting surface and extending away from the surface and a second tensioned rod in the other of said slabs being anchored contiguous to the abutting surface and extending away from said surface in a direction opposite to that of the first rod a connector for joining said first and second tensioned rods together, said connector having a pair of halves, said halves being connected to respective rod ends at the abutting surfaces and being fixedly mounted on adjacent surfaces of each of the slabs, each of said connector halves having mutually parallel bases, each base having a pair of spaced walls projecting therefrom, each wall of each pair being disposed in overlapping relationship to a respective wall of the other pair, the confronting surfaces of the overlapping walls having mating slots therein, each of said slots having at least one sloping edge to form an enclosed groove in each pair of confronting surfaces, and a pair of elongated wedges, each having at least one sloping edge, the edges of the wedges mating with the edges of the slots, one of said wedges being inserted into each of the enclosed grooves so that a camming surface is formed between the sloping edge of each slot and wedge.

2. The combination of claim 1 wherein each of said walls has an edge extending at right angles to longitudinal axes of the wedges, and lips on at least one of the bases extending at right angles to the edges of the wedges and into engagement with the edges of wedges.

3. The combination of claim 1 wherein each of the rods extends through bases on remote surfaces of the

6

slabs, and means for securing each of the rods in situ on the faces on the remote surfaces.

4. The combination of claim 3 wherein a cut-out is provided in one of the abutting surfaces, one of said bases being fixedly mounted in the cut-out, another of said bases being fixedly mounted on an abutting surface of a slab adjacent the slab having the cut-out, said another base-carrying walls projecting into the cut-out.

5. The combination of claim 1, wherein each of the slabs is provided with a bore through which the tensioned rods extend.

6. The combination of claim 5 further including adhesive means for the rod and slab substantially filling the bore.

7. A connector particularly adapted for interconnecting precast concrete slabs comprising a pair of connector halves, each of said connector halves having mutually parallel bases, each base having a pair of spaced walls projecting therefrom, each wall of each pair being disposed in overlapping relationship to a respective wall of the other pair, the confronting surfaces of the overlapping walls having mating slots therein, each of said slots having at least one sloping edge to form an enclosed groove in each pair of confronting surfaces, and a pair of elongated wedges, each having at least one sloping edge, the edges of the wedge mating with the edges of the sloping slots, one of said wedges being inserted into each of the enclosed grooves so that a camming surface is formed between the sloping edge of each slot and each wedge.

8. The connector of claim 7 wherein each of said walls has an edge extending at right angles to longitudinal axes of the wedges, and lips on at least one of the bases extending at right angles to the edges of the wedges and into engagement with the edges of wedges.

9. The combination recited in claim 1 wherein said first tensioned rod is in coaxial alignment with said second tensioned rod.

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U.S. Cl. X.R.

52—583, 584; 287—64